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WEATHER MODIFICATION OPERATIONS IN CALIFORNIA

October 1, 1967 — September 30, 1968

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FOREWORD

Thirty-nine years ago, in the late summer of 1930, the Dutch meterologist August W. Veraart carried out an unusual experiment. Flying at an altitude of some 2,000 feet, Veraart shoveled a half ton of chipped ice into several clouds. The result was the first actual artificially produced rainstorm, which lasted about twenty minutes. Although the experiment aroused some interest among scientists, most remained skeptical, and it was not until 1946 that Dr. Irving Langmuir and others successfully used dry ice (solid carbon dioxide) to produce snow and, ultimately, rain.

Twenty years later, in 1966, the publication of a report by the National Academy of Sciences marked a turning point in the opinion of scientists on the subject of weather modification. Today, almost all authorities agree that it is a subject of prime importance and deserving of scientific inquiry and engineering development.

In California, weather modification has had an active history for almost two decades. Such operations within the State are governed by Chapter 4, Division 1, Sections 400 through 415, of the Water Code. These sections prescribe procedures for licensing contractors and for initiating and reporting a project. The sections also describe special cases and indicate penalties for violation of the statute. The Department of Water Resources administers the provisions of the Water Code governing weather modification operations in California.

This bulletin, the thirteenth in a continuing series, describes weather modification projects and evaluation techniques in California, according to data in notices of intention, project completion reports, and project evaluation reports submitted to the Department under requirements of the Water Code.

William R. Gianelli

William R. Gianelli, Director
Department of Water Resources
The Resources Agency
State of California
July 22, 1969

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State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES

RONALD REAGAN, Governor, State of California
WILLIAM R. GIANELLI, Director, Department of Water Resources
JOHN R. TEERINK, Deputy Director

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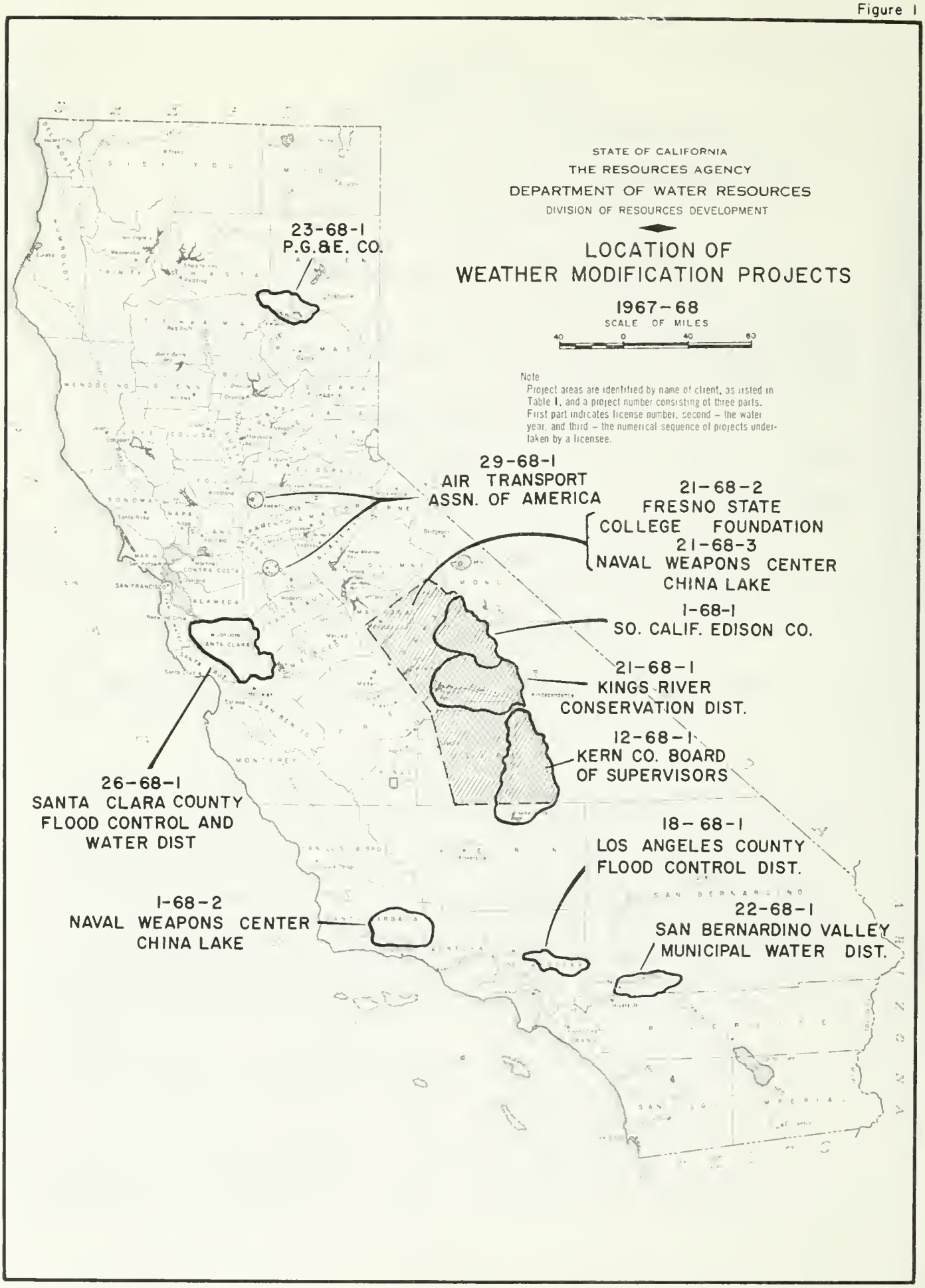
Editorial assistance was furnished by Reports Administration

ABSTRACT

Eight California licensees conducted eleven weather modification projects during the 1967-68 water year. Eight of these projects were carried out primarily to increase precipitation. One was a fog-dispersal program, and two were applied research programs designed to (1) develop information on seeding effects and seeding rates, (2) obtain measurements of freezing and condensation nuclei, and (3) provide information on the effectiveness of modern pyrotechnic cloud-seeding devices. / Four projects were conducted over the Central and Southern Sierra Nevada Mountains, three in Central California, and one in Northern California. / In all projects except the fog-suppression program, silver iodide was used as the only nucleating agent.

Figure 1


STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES DEVELOPMENT
LOCATION OF
WEATHER MODIFICATION PROJECTS
1967–68
SCALE OF MILES
40 0 40 80
Note
Project areas are identified by name of client, as listed in Table I, and a project number consisting of three parts. First part indicates license number, second – the water year, and third – the numerical sequence of projects undertaken by a licensee.
23-68-1
P.G.&E. CO.
29-68-1
AIR TRANSPORT
ASSN. OF AMERICA
21-68-2
FRESNO STATE
COLLEGE FOUNDATION
21-68-3
NAVAL WEAPONS CENTER
CHINA LAKE
1-68-1
SO. CALIF. EDISON CO.
21-68-1
KINGS RIVER
CONSERVATION DIST.
12-68-1
KERN CO. BOARD
OF SUPERVISORS
26-68-1
SANTA CLARA COUNTY
FLOOD CONTROL AND
WATER DIST
18-68-1
LOS ANGELES COUNTY
FLOOD CONTROL DIST.
1-68-2
NAVAL WEAPONS CENTER
CHINA LAKE
22-68-1
SAN BERNARDINO VALLEY
MUNICIPAL WATER DIST.

INTRODUCTION

During the 1967-68 water year (October 1967 through September 1968), eight licensees conducted eleven weather modification projects. These projects are listed in Table 1.

In Table 1 and throughout this report, each project is given a three-part number, each part separated by a dash. The first part consists of one or two digits which is the license number of the licensee doing the seeding. The second part consists of the last two digits of the calendar year ending the water year with which we are concerned. The third part is a number sequentially labeling the projects operated by each licensee.

As an example, 23-68-1 is a project in which operations are carried out under License 23 during the 1967-68 water year and is the only project, or the first of several, carried out by the licensee.

Table 2 lists license number and licensee for weather modification licenses issued for the calendar year 1968.

A map depicting the location of California weather modification project target areas by project and client is shown in Figure 1. The days of cloud seeding from October 1, 1967, through September 30, 1968, are also summarized by project number and name of client in Figure 2. The days of cloud seeding are the days on which seeding operations took place. Seeding did not necessarily occur during all the hours of the day. (See pages 12 and 13.)

During 1967-68 operational period, all projects except the fog suppression project, 29-68-1, dispursed silver iodide (AgI) as the only nucleating agent.

Project 1-68-2, Project Sierra Cumulus 21-68-2, and the Southern Sierra Range Project 21-68-3 were all operated as applied research programs on various aspects of weather modification. Project 23-68-1 was operated on a random basis in order to better evaluate the program and the 1967-68 season was the sixth year of a randomized seeding program. All other projects were operated primarily to modify the prevailing weather, i. e., to increase precipitation or to disperse fog.

TABLE 1. SUMMARY OF WEATHER MODIFICATION PROJECTS IN CALIFORNIA, OCTOBER 1, 1967 – SEPTEMBER 30, 1968

Project No.	Licensee	Client	Target Area	Purpose
1-68-1	North American Weather Consultants	Southern California Edison	Upper San Joaquin River Basin	Precipitation increase for hydrologic generation
1-68-2	North American Weather Consultants	Naval Weapons Center, China Lake	Upper Santa Ynez Valley and San Rafael Mountains	Precipitation increase research
12-68-1	Precipitation Control Co., of Calif	Kern County	Upper Kern River Watershed	Precipitation increase for water supply
18-68-1	Los Angeles County Flood Control District	Los Angeles County Flood Control District	Watersheds of San Gabriel, Tunjunga, and Pacoima Rivers	Precipitation increase for water supply
21-68-1	Atmospherics, Inc	Kings River Conservation District	Kings River Drainage Basin above Pine Flat Dam	Precipitation increase for water supply
21-68-2	Atmospherics, Inc	Fresno State College Foundation – AWRR	Southern Sierra Mountains	Applied research on precipitation increase from orographic cumulus clouds
21-68-3	Atmospherics, Inc	Naval Weapons Center, China Lake	Southern Sierra Mountains	Testing of effects of pyrotechnic nuclei generators
22-68-1	San Bernardino Valley Municipal Water District	San Bernardino Valley Municipal Water District	Upper Santa Ana River Watershed east of Lytle Creek and north of San Bernardino County	Precipitation increase for water supply and recreation
23-68-1	Pacific Gas and Electric Co	Pacific Gas and Electric Co	Drainage Basin above Mountain Meadows and Butte Valley Reservoirs and Lake Almanor	Precipitation increase for hydroelectric generation
26-68-1	Santa Clara County Flood Control and Water District	Santa Clara County Flood Control and Water District	Santa Clara County	Precipitation increase for water supply
29-68-1	World Weather, Inc	Air Transport Association of America	Sacramento Metropolitan Municipal and Stockton Airports	Fog dispersal

TABLE 2. WEATHER MODIFICATION LICENSES ISSUED FOR CALENDAR YEAR 1968

License Number and Licensee:

1. North American Weather Company
   Santa Barbara Municipal Airport
   Goleta, California 93917

5. Water Resources Development Carporation Corporation
   611 Palm Canyon Drive, Suite 216
   Palm Springs, California 92262

12. Precipitation Control Company of California
    105 Pierce Street
    Taft, California 93268

18. Los Angeles County Flood Control District
    P.O. Box 2418, Terminal Annex
    Los Angeles, California 90033

21. Atmospherics, Incorporated
    4981 East Dakota Avenue
    San Bernardino, California 92402

22. San Bernardino Valley Municipal Water District
    355 North D Street, P.O. Box 1144
    San Bernardino, California 92402

23. Pacific Gas and Electric Company
    245 Market Street
    San Francisco, California 94106

24. International Weather Control, Incorporated
    40 West First Street, Suite 104
    Reno, Nevada 89501

25. K.R.C. Service Corporation
    2956 C Street
    San Diego, California 92102

26. Santa Clara County Flood Control and Water District
    15420 Almaden Road
    San Jose, California 95118

27. Vista Irrigation District
    P.O. Box 1088
    Vista, California 92083

28. Weather Science, Incorporated
    1808 Newton Drive
    Norman, Oklahoma 73069

29. World Weather, Incorporated
    1510 Ranson Drive
    Houston, Texas 77055

30. Fresno State College Foundation
    Atmospheric Water Resources Research
    4831 East Shields Avenue
    Fresno, California 93726

31. Weather Measure Corporation
    P.O. Box 41257
    Sacramento, California 95841

32. Desert Research Institute
    University of Nevada System
    Reno, Nevada 89507

33. E. Bollay Associates, Incorporated
    P.O. Box 1022
    Boulder, Colorado 80301

The following project descriptions are derived from notices of intention, project completion and evaluation reports submitted to the Department by licensees.

Upper San Joaquin River Basin Weather Modification Project (1-68-1)

Between November 1, 1967, and July 9, 1968, North American Weather Consultants conducted weather modification operations in the San Joaquin River Basin for Southern California Edison Company. The purpose of this project, which has been operated for 17 consecutive years, is to increase snowpack in the drainage area of the Upper San Joaquin River Basin above Powerhouse No. 8. Equipment was operated in the vicinity of Mammoth Pool, Huntington Lake, Shaver Lake, Florence Lake, Lake Thomas A. Edison, Kaiser Pass, and adjacent foothill areas in the central portions of Fresno and Madera Counties. The target area, Figure 3, was the drainage area of the Upper San Joaquin River and tributary streams in the eastern portions of Fresno and Madera Counties. Precipitation in the San Joaquin River Basin above SCE Powerhouse No. 8 may have been affected by the project.

TABLE 3 GENERATOR HOURS OF OPERATION BY MONTH PROJECT 68 1

Location	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Total
[illegible]	27.5	0	32.5	71.8	63.8	25.5	11.0	0	2.8	24[illegible]
[illegible]	27.5	0	32.5	74.2	63.8	42.2	0	0	12.8	253.0
[illegible]	[illegible]	[illegible]	58.2	68.8	44.2	19.2	34.0	0	0	266.4
[illegible]	27.5	61.8	58.2	72.2	69.2	24.8	24.9	20.8	2.8	372[illegible]
[illegible]	41.0	0	58.2	63.8	51.2	[illegible]	43.0	19.2	[illegible]	295.6
[illegible]	0	30.0	57.5	72.2	56.8	42.2	54.2	40.5	0	35[illegible].4
[illegible]	30.5	44.8	49.2	68.8	38.2	9.2	17.5	0	0	268.2
Pine Ridge	37.0	33.0	37.5	29.0	20.5	19.5	0	0	0	176.5
Auberry	0	35.0	37.5	20.0	20.8	19.8	0	0	0	133.1
Tollhouse	12.8	25.5	37.5	29.2	19.8	19.8	0	0	0	144.6
South Fork	25.2	41.8	38.0	7.0	20.8	20.0	0	0	0	152.8
Bass Lake	21.2	37.0	18.5	0	16.5	19.5	0	0	0	112.7
Totals	262.2	338.9	515.3	577.0	485.6	290.9	184.5	80.5	38.4	2,773.3

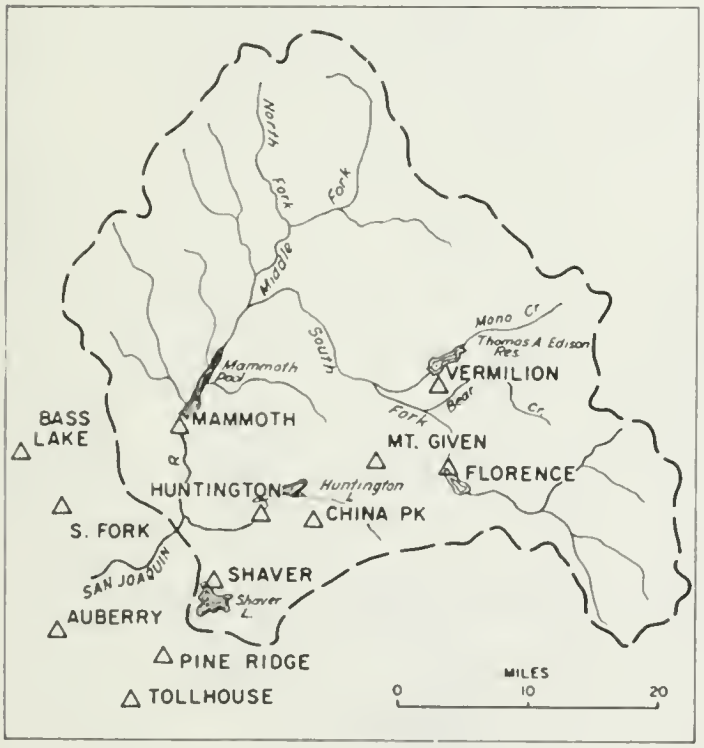


Figure 3. Target Area and Generator Locations, Project 1-68-1

Project equipment included 12 ground-based radio-controlled generators, emiting silver iodide at the rate of 6 grams per hour per generator. Generators were operated in the same locations as during the 1966-67 season.

Monthly totals of generator-hours for each generator are given in Table 3. Table 4 is a summary of project operations including the number of storms, days of seeding, and amounts of silver iodide used.

TABLE 4 SUMMARY OF OPERATIONS, PROJECT 1-68 1

Month	No. of Storms	Days of Seeding	AgI Used, gm
November	5	7	1,573.5
December	5	7	2,032.5
January	7	8	3,093.0
February	6	8	3,462.0
March	6	6	2,913.0
April	4	4	1,746.0
May	7	8	1,107.0
June	4	4	483.0
July	2	2	229.5
Totals	46	54	16,639.5

Santa Ynez Valley Weather Modification Project (1-68-2)

Beginning on January 27, 1968, and extending through April 1, 1968, North American Weather Consultants initiated a weather modification project on behalf of the Naval Weapons Center, China Lake, California. The purpose of the project is to increase precipitation in the Santa Ynez Valley above Solvang and the San Rafael Mountains. Seeding was accomplished by disbursing silver iodide by pyrotechnics from one ground-based generator located at El Capitan Lodge. Project operations are summarized in Table 5. The generator location and target area are shown in Figure 4.

TABLE 5 SUMMARY OF OPERATIONS, PROJECT 1-68-2

Month	No of Storms	Days of Seeding	Hours of Operation	AgI Used, gm
December	2	0	0	0
January	3	2	1 2	450
February	2	3	2 2	975
March	3	3	3 9	1,275
April	1	1	10.5	675
Totals	11	9	17 8	3,375

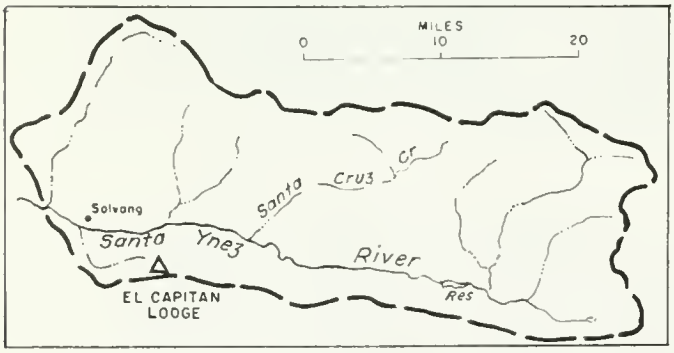


Figure 4. Target Area and Generator Locations, Project 1-68-2

Upper Kern River Project (12-68-1)

Between November 19, 1967 and May 13, 1968, Precipitation Control Company of California conducted weather modification operations in the Upper Kern River Basin on behalf of the Kern County Board of Supervisors. The purpose of this project is to increase surface runoff by increasing precipitation.

The technique used in the seeding operations was the dispensing of silver iodide smoke from aircraft at a rate of approximately one and one-half ounces per hour.

Figure 5 is a map of the target area, and Table 6 presents a summary of operation for the project during the 1967-68 season.

TABLE 6 SUMMARY OF OPERATIONS, PROJECT 12-68-1

	Nov	Dec	Jan	Feb	Mar	Apr	May	Total
No. of Storms	3	4	3	4	4	2	2	22
No of Flights	7	9	5	7	7	4	2	41
Flight Time, Hours	15.9	24 6	7.5	13.6	20.9	6 7	3.7	92 9
AgI Used, ounces	23 8	36.9	11 2	20 4	31 4	10 0	5.6	139.3
Grams	674 0	1,046 0	317 0	578 0	890 0	283 0	159 0	3,947.0

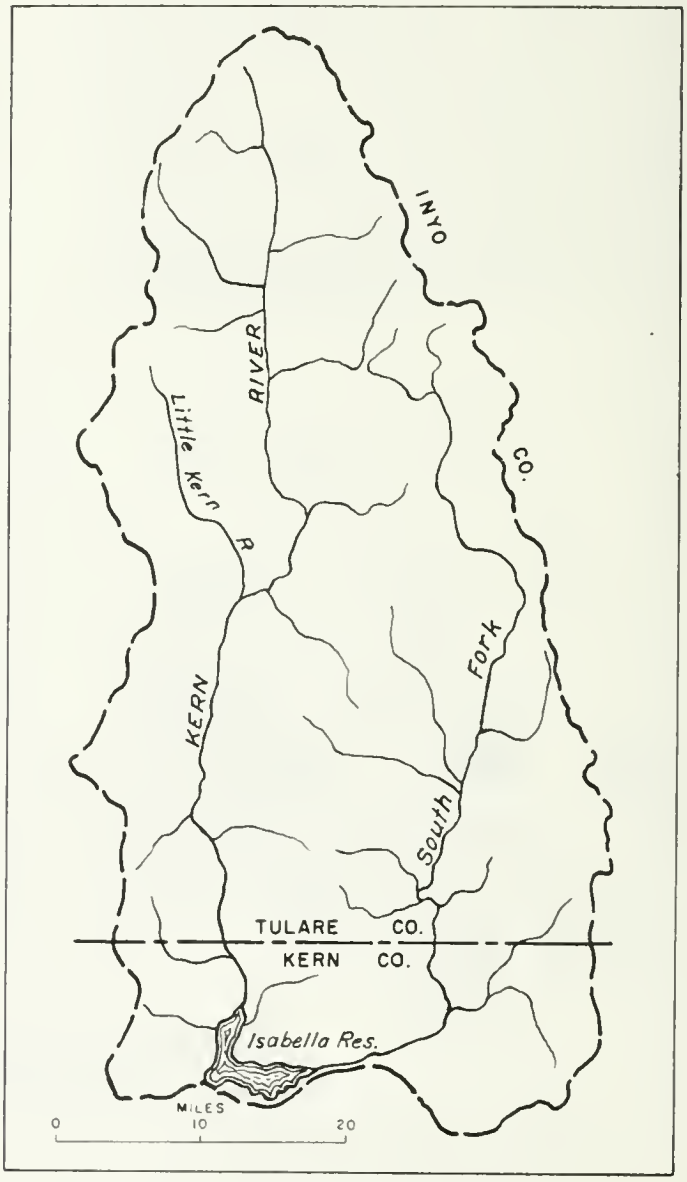


Figure 5. Target Area, Project 12-68-1

Artificial Nucleation Program in the San Gabriel River, Big Tujunga, and Pacoima Drainage Basins (18-68-1)

Between November 19, 1967, and April 2, 1968, the Los Angeles County Flood Control District conducted a weather modification project to increase precipitation above district-owned dams in the San Gabriel Mountains.

Sixteen ground-based generators were operated adjacent to drainage areas tributary to district-owned dams. The target area was the southerly slopes of the San Gabriel Mountains including the drainage area above Pacoima Dam on west to the drainage area above Thompson Creek Dam on the east. Sixteen ground-based generators were used to disburse a two-percent solution of silver iodide at a rate of 6.0 grams per hour. The generators were located to the south of the target area and were the same as those used during the 1966-67 season. The target area and generator locations are shown in Figure 6. Monthly totals of operation hours for each generator are given in Table 7. Project operations are summarized in Table 8.

TABLE 7 GENERATOR HOURS OF OPERATION, PROJECT 18-68-1

Location	Nov	Dec	Jan	Feb	Mar	Apr	Total
Pacoima Spreading Grounds	10.8	0	0	0	0	11.8	22.6
LaTuna Debris Basin	10.0	0	0	0	21.8	11.8	43.6
Pickens Patrol Station	24.2	3.5	9.5	0	19.0	4.2	60.4
Devils Gate Dam	25.0	5.0	11.0	16.5	20.2	4.2	81.9
Eaton Spreading Basin	22.2	5.8	4.8	17.0	19.8	4.2	73.8
Longden Yard	15.2	4.8	4.0	16.2	19.8	4.2	64.2
Ben Lomond Spreading Grds	30.5	1.8	4.2	16.8	16.5	2.5	72.3
Puddingstone Dam	1.2	3.0	0	16.5	0	4.0	24.7
Thompson Cr Dam	2.5	0	0	0	0	0	2.5
Mt Baldy Guard Station	2.5	0	0	0	0	0	2.5
Tanbark Flats	2.2	0	41.5	0	0	0	43.7
Pine Mountain	44.2	6.8	10.2	30.0	22.0	15.8	129.0
Spring Camp	32.8	12.0	10.2	30.0	26.5	15.8	127.3
Mt Wilson	32.5	6.0	6.2	30.5	23.5	15.8	114.8
Red Box Ranger Station	9.8	2.5	13.2	30.5	21.2	15.8	103.0
Big Tujunga Dam	21.2	12.2	13.2	31.0	26.0	16.0	119.6
Totals	287.1	73.4	128.0	235.0	236.3	126.1	1,085.9

TABLE 8 SUMMARY OF OPERATIONS, PROJECT 18-68-1

Month	No. of Storms	Days of Seeding	AgI Used, gm
November	2	4	[illegible]
December	1	2	44
January	2	4	768
February	1	2	4.0
March	2	1	4.8
April	—	2	757
Totals	9	17	6,514

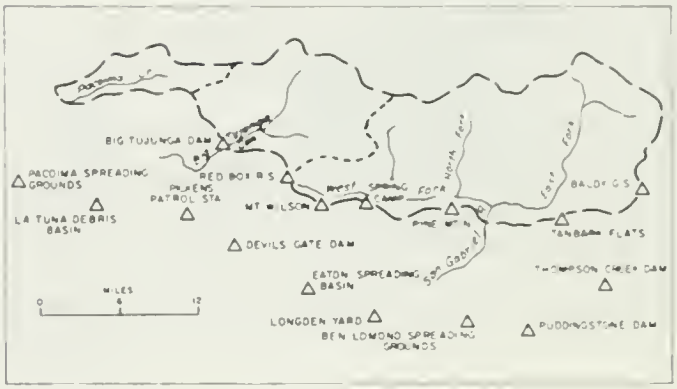
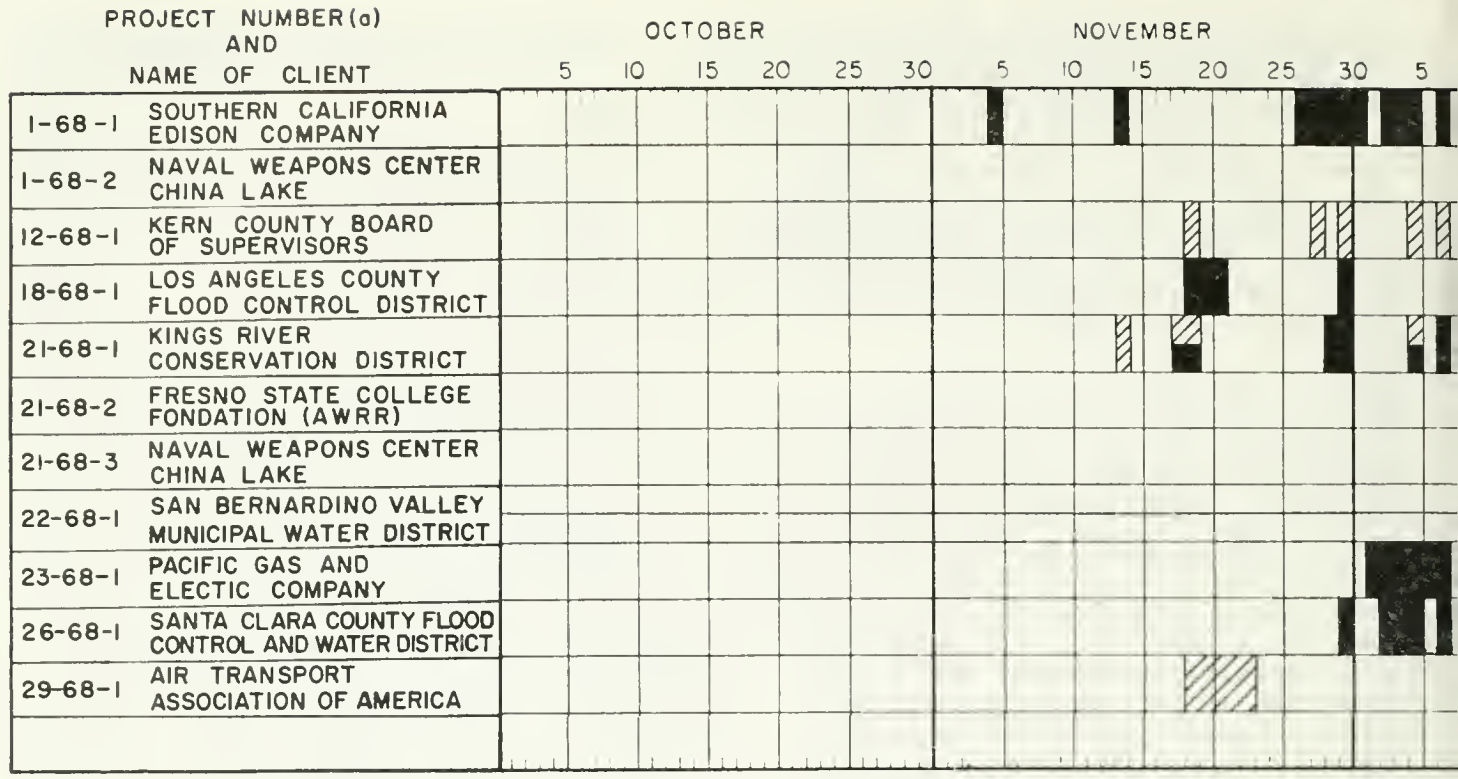


Figure 6. Target Area and Generator Locations, Project 18-68-1

Kings River Weather Modification Program (21-68-1)

Between November 13, 1967, and April 1, 1968, Atmospherics Incorporated conducted a weather modification project in the Kings River watershed above Pine Flat Dam on behalf of the Kings River Conservation District. Equipment included a turbocharged Piper Aztec "C" aircraft equipped with dual-omni Distant Measuring Equipment, and radio transponder; a radar system operated on a frequency of 9380 megacycles with a maximum range of 200 miles; a total of 24 ground-based generators; and a mobile unit operating along Highway 180. The target area and generator location are shown in Figure 7.

Ground-based generators disbursed 3366 grams of silver iodide, and 3364 grams of silver iodide were disbursed along



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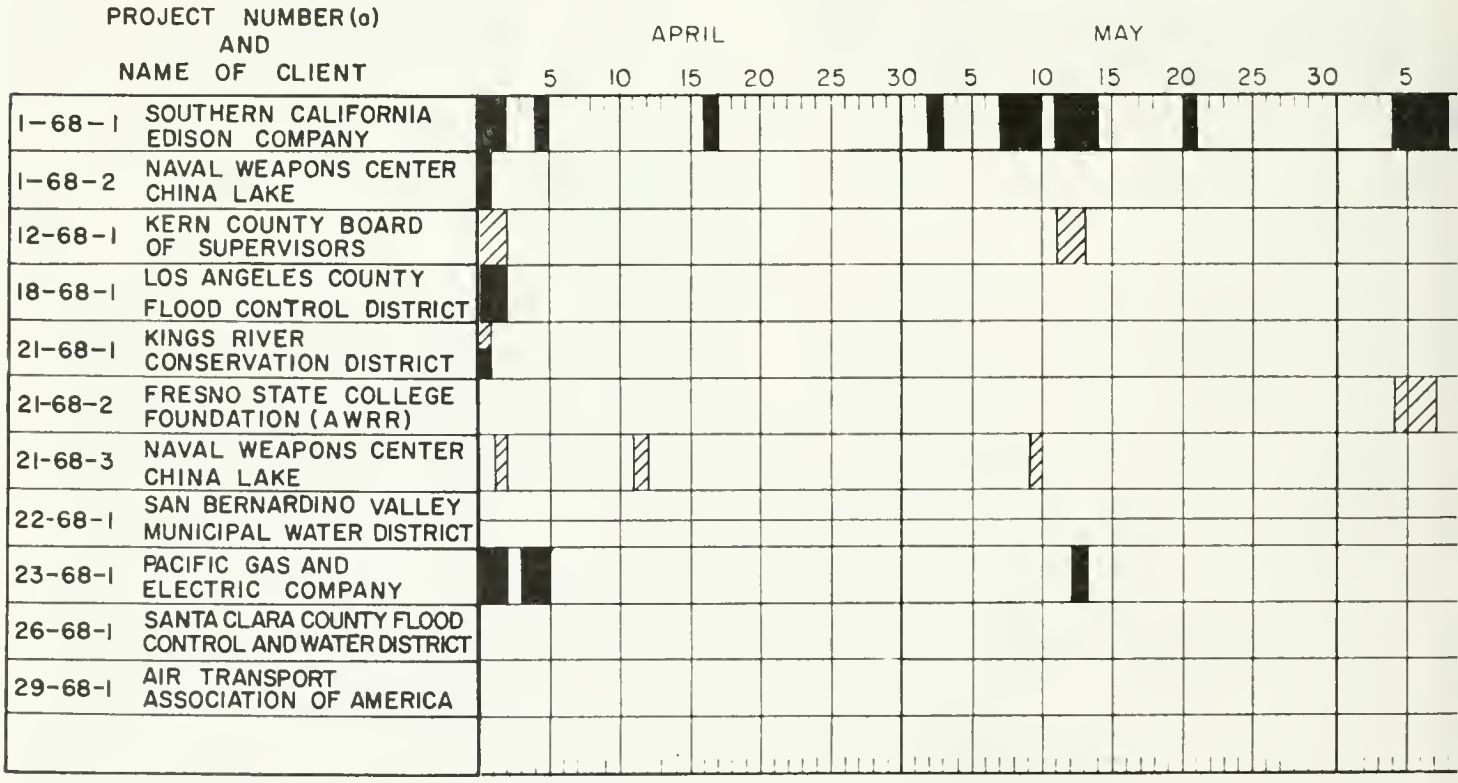
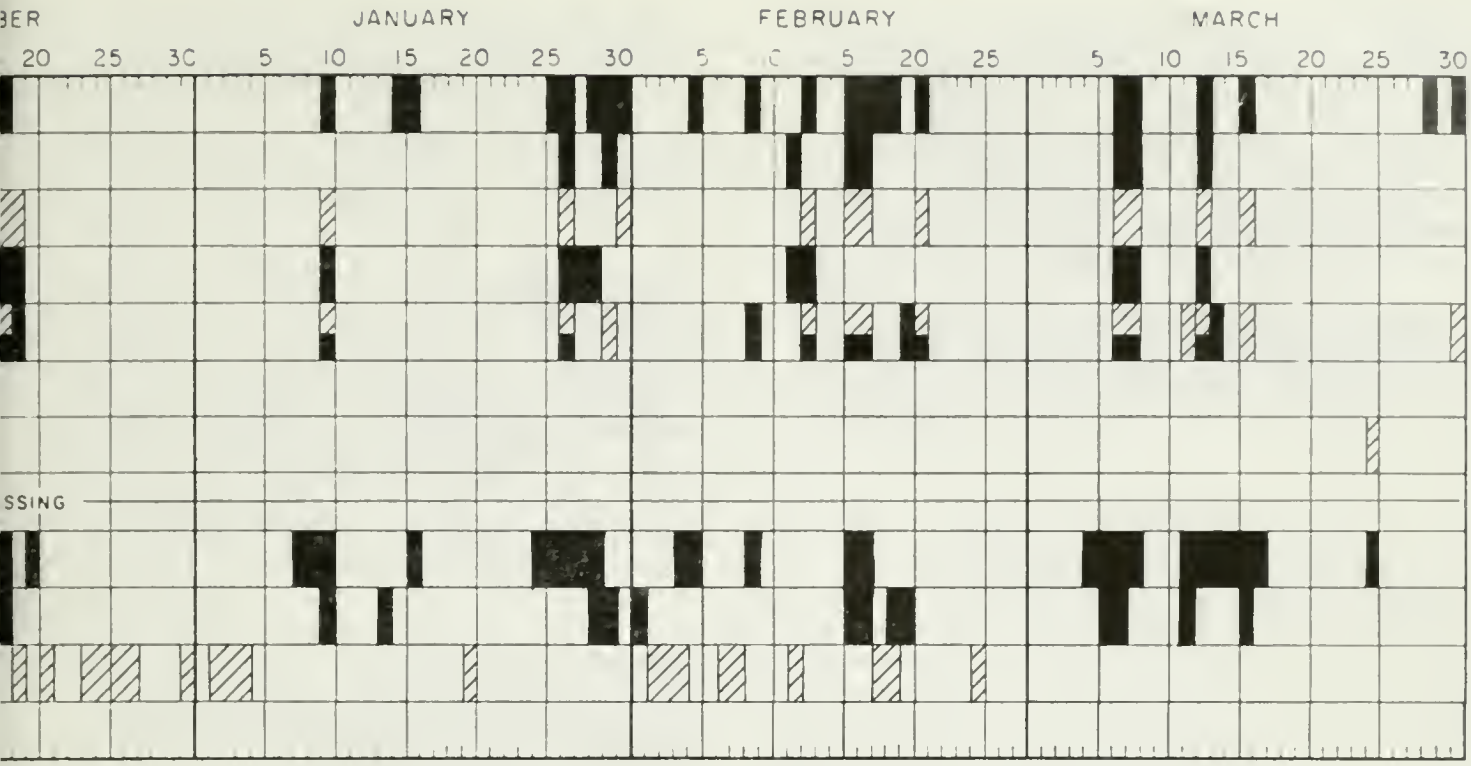


(a) Project number consists of three parts: first part indicates license number, second – the water year; and third – numerical sequence of projects undertaken by a licensee.

Figure 2



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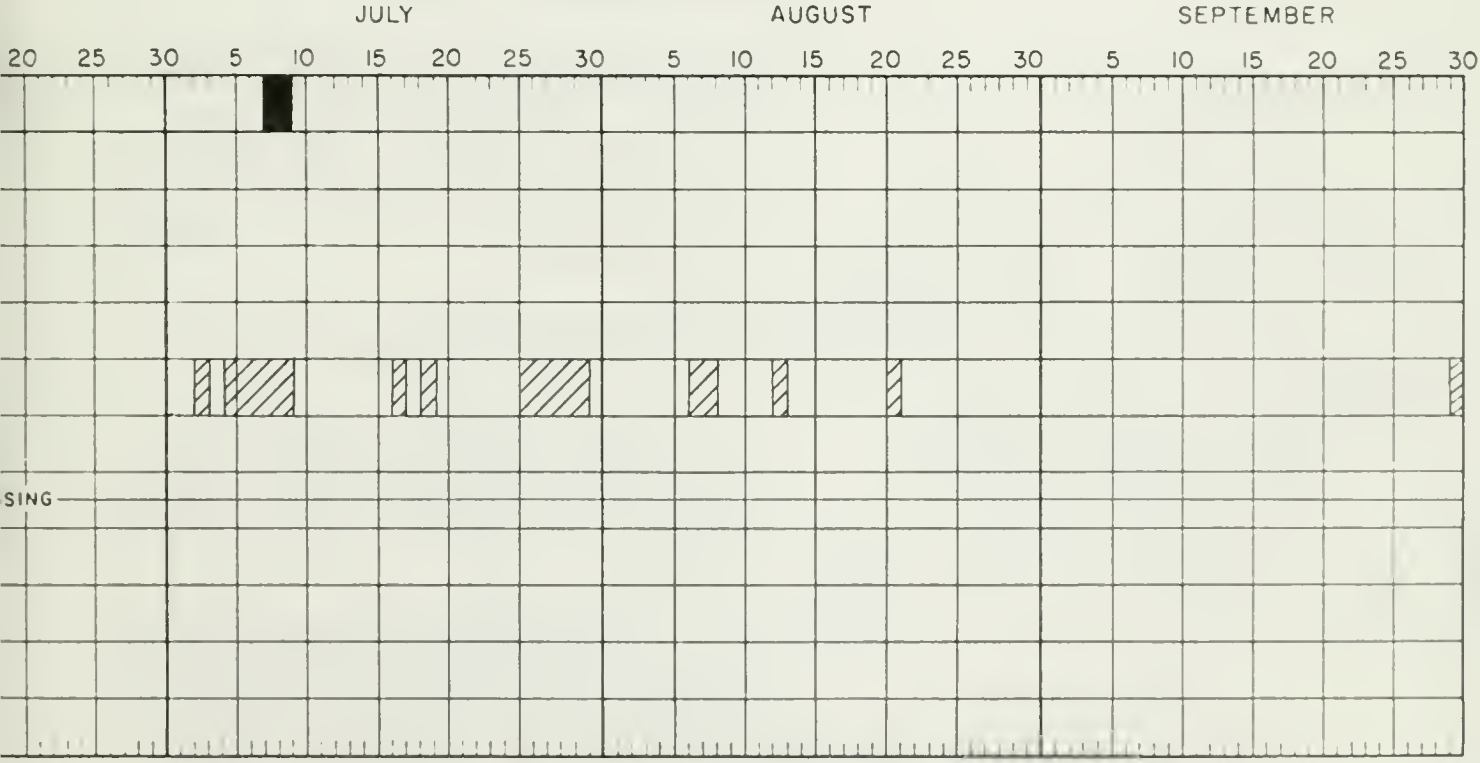


1968 WEATHER MODIFICATION OPERATIONS IN CALIFORNIA

DAYS OF CLOUD SEEDING

ASED GENERATORS

OCTOBER 1967 THROUGH SEPTEMBER 1968

Highway 180 by a mobile unit. During 23 aircraft flights, 3210 grams of silver iodide were disbursed. Ground-based generators vaporized about 14 grams of silver iodide per hour suspended in an acetone solution. Pyrotechnic devices were used to disburse silver iodide from the mobile unit and aircraft.

Summaries of generator hours operated by months and of project operations are presented in Tables 9 and 10.

TABLE 9 GENERATOR-HOURS OF OPERATION BY MONTH, PROJECT 21-68-1

Generator	Nov	Dec	Jan	Feb	Mar	Apr	Total
G5	0	0	0	24.9	0	0	24.9
G7	0	0	0	0	1.0	0	1.0
G8	0	0	0	24.9	0	0	24.9
G10	0	0	0	31.8	13.3	0	45.1
G13	0	9.8	9.9	13.1	0	0	32.8
G14	25.7	9.8	0	6.2	0	0	41.7
G15	36.0	9.8	0	6.2	0	0	52.0
G16	0	0	9.9	0	0	0	9.9
G18	0	0	9.9	0	0	0	9.9
G21	0	4.0	0	0	0	0	4.0
G22	0	4.0	0	1.0	0	0	5.0
G23	0	4.0	0	7.9	13.4	0	25.3
G24	0	4.0	0	0	0	0	4.0
Mobil	0	10.9	3.7	4.7	18.5	9.0	46.8
Aircraft	1.6	5.3	10.4	10.4	14.6	2.4	44.7
Total[1]	61.7	56.3	33.4	120.7	46.2	9.0	327.3

1. Aircraft operations not included in total. Generators 1, 2, 3, 4, 6, 9, 11, 12, 17, 19, and 20 were not operated.

TABLE 10 SUMMARY OF OPERATIONS, PROJECT 21-68-1

Operation	Nov	Dec	Jan	Feb	Mar	Apr	Total
Aircraft							
Silver Iodide, grams	81	315	745	810	1,080	180	3,211
No. of flights	1	3	5	5	8	1	23
Ground Generators							
Silver Iodide, grams	740	545	356	1,392	332	0	3,365
Time, hrs	61.7	45.4	29.7	116	27.7	0	280.5
Mobile Unit							
Silver Iodide, grams	0	900	460	275	1,375	354	3,364
Time, hrs	0	10.9	3.7	4.7	18.5	9	46.8
Totals							
Silver Iodide, grams	821	1,760	1,561	2,477	2,787	534	9,940
Time, hrs	61.7	56.3	33.4	120.7	46.2	9	327.3

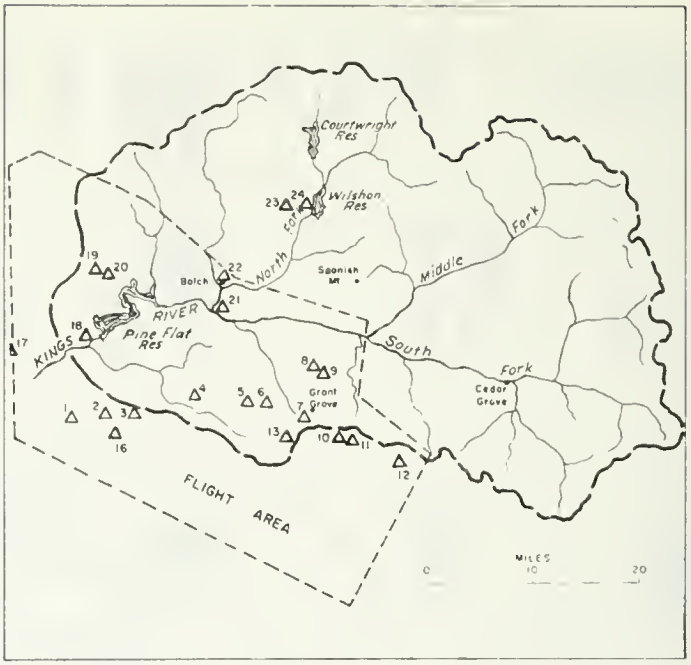


Figure 7. Target Area and Generator Locations, Project 21-68-1

Sierra Cumulus Project (21-68-2)

Between June 1, 1968 and September 30, 1968, Atmospherics Incorporated, under contract to the Fresno State College Foundation, Atmospheric Water Resources Research, completed the third season of an applied research project on precipitation production from summer orographic cumulus clouds.

There were three programs within the project during the summer of 1968.

1. The Cloud Pairs Seeding Program, in which the aerial application of silver iodide to randomly selected cumulus turrets developing over the Sierra range continued as in the previous season.

2. The Bear Creek Basin Area Seeding Program, in which extensive aerial application of silver iodide to summer cloud developments over the Bear Creek Basin continued as in the previous season. The basin is one of the high altitude sub-basins within the San Joaquin River Watershed.

3. Kings River Area Seeding Program, in which supplemental seeding flights over the Kings River Watershed were made in order to augment the precipitation during an extremely low water year. This program was funded by the Kings River Conservation District.

All seeding was accomplished from aircraft using pyrotechnic devices to disburse silver iodide nuclei. Radar, visual, and photographic observations were made during the course of the project. Observations were also made of the liquid water content of the clouds (LWC), hydrometer size distributions, temperatures, and atmospheric vertical velocities.

The analysis of the data will be carried out by Fresno State College Foundation, Atmospheric Water Resources Research and hydrologic studies by Sierra Hydro-Tech of El Dorado, California.

TABLE 11 AIRCRAFT FLIGHT SUMMARY, PROJECT 21-68-2

Flt No	Date (68)	Takeoff	Land	Time, Hrs	Cum Time	Purpose of Flight
1	6 5	1333	1549	2 3	2 3	Kings River area seeding No. 1 and No 2
2	6 6	1432	1629	1 9	4 2	Kings River area seeding No 3
3	6 7	1249	1442	1 9	6 1	Cloud pairs test case No 1
4	7 3	1500	1627	1 4	7 5	Test flight of dropsonde system
5	7 5	1343	1638	2 9	10 4	Kings River area seeding No 4
6	7 6	1220	1535	3.3	13.7	Cloud pairs test case No 2 and Bear Creek area test case No 1
7	7 7	1124	1331	3 1	16 8	Bear Creek area test case No. 2
8	7 8	1245	1705	4 3	21 1	Bear Creek area test case No. 3 and Kings River area seeding No 5
9	7 9	1216	1634	4 3	25 4	Bear Creek area test case No. 4 and Kings River area seeding No. 6
10	7 17	1538	1704	1 4	26 8	Test flight of transponder radar system
11	7 19	1422	1558	1 6	28 4	Test flight of dropsonde
12	7 26	1339	1700	3 3	31 7	Cloud pairs test case No. 3
13	7 27	1252	1650	4 0	35 7	Bear Creek area test case No. 5 and Kings River area seeding No. 7
14	7 28	1245	1537	2 7	38 4	Kings River Area seeding No 8
15	7 29	1259	1630	3 5	41 9	Bear Creek area test case No 6 and Kings River area seeding No 9
16	7 30	1308	1712	4 1	46 0	Bear Creek area test case No 7
17	8 7	1157	1410	2 2	48 2	Seeding-observation flight (conditions unsatisfactory)
18	8 8	1349	1701	3 2	51 4	Cloud pairs test case No 4
19	8 13	0945	1325	3 7	55 1	Bear Creek area test case No 8 and Kings River area seeding No 10
20	8 21	1036	1406	3.5	58 6	Bear Creek area test case No 9
21	8 21	1557	1922	3 4	62 0	Bear Creek area test case No 10 and Kings River area seeding No. 11
22	9 29	1507	1700	1 9	63 9	Bear Creek area test case No 11

The aircraft flights for all three programs are summarized in Table 11. Table 12 and Figure 8 present the data and location for the Cloud Pairs Seeding Program. Information on the Bear Creek Basin Area Seeding Program is shown in Table 13 and Figure 9. The Kings River Area Seeding Program data are provided in Table 14 and Figure 10. The tables and test case locations were taken from a report titled "Project Sierra Cumulus, 1968 Season," 20 December 1968 prepared by Atmospherics Incorporated, Fresno, California.

TABLE 12 CLOUD AND PRECIPITATION DATA CLOUD PAIRS SEEDING, PROJECT 21-68-2

Test Case	Date	Alt[1]	Temp °C	Est Cloud Top Alt[1]	Seeding Alt[1]	Seeding Temp	LWC gm/m³	AgI used, gm	Precipitation Seeded	Precipitation Not Seeded	Reached Ground Seeded	Reached Ground Not Seeded
1	6 7	6.8	+4.5	16	12.0	-6	-	7.5	Yes	Yes	Yes	Unknown
2	7 6	16.9	-6	24	16.9	-6	-	70 0	Yes	Yes	Yes	Unknown
3	7 26	14 4	+1	24	17.5	-5.5	2-0.35	30.0	Yes	No	Yes	No
4	8 8	12.5	+5	22	18 1	-8	.2-0 4	30 0	Yes	No	Yes	No
Average		12.6	1.2	21.5	16.1	-6.4	0.28					

Total Silver Iodide used for seeding 137.5 grams

1 in 1000's of feet

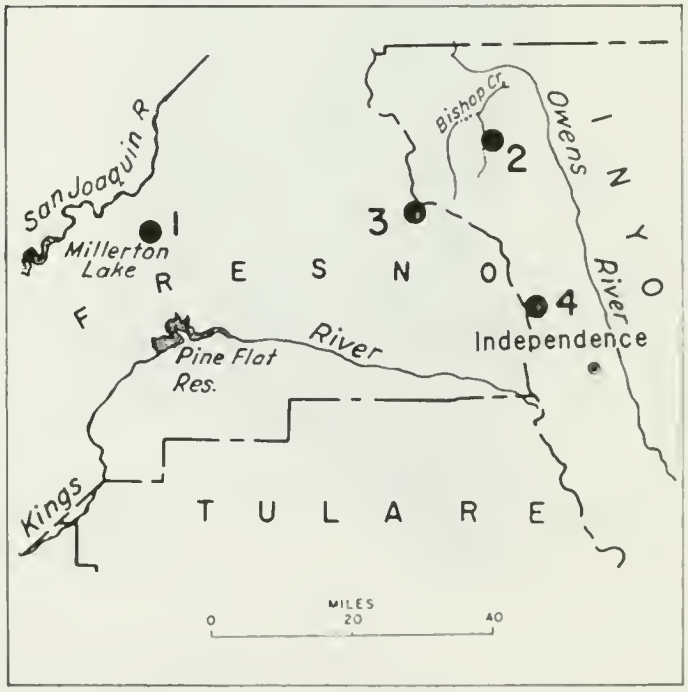


Figure 8. Operational Area and Test Case Locations, Cloud Pairs Seeding Program, Project 21-68-2

TABLE 13 CLOUD AND PRECIPITATION DATA BEAR CREEK AREA SEEDING, PROJECT 21-68-2

Test Case No	Date	Location or Line	Cloud Base Alt 1/	Cloud Base Temp, °C	Seed Alt 1/	Seed Temp	LWC gm/m³	AgI Used gm	Precip	Precip on Ground	Area of Precip
1	7 6	5-10 mi SE of target	16 5	−6	16 5	−6	–	58	Yes	Yes	wide spread
2	7 7	2-5 mi NE of target	16 0	−4	16 0	−4	0 20	44	Yes	Yes	2+ sq mi
3	7 8	1-10 mi E of target	11.5	+4 5	14 2	0	0 26	154	Yes	Yes	wide spread
4	7 9	over target	10 6	+6	10 6	+6	–	238	Yes	Yes	40 sq mi
5	7 27	E half of target	14 4	+0 5	14 4	+0 5	0 30	45	Yes	Yes	wide-spread
6	7 29	Over target	12 3	+3 5	12 3	+3 5	0 10-0 20	14	Yes	Yes	wide spread
7	7 30	Over target	12 4	+4	12 5	+4	0 09-0 14	44	Yes	Yes	6-10 sq mi
8	8 13	Over target 8 mi South	10 7	0	10 7	0	0.15-0.28	90	Yes	Yes	8 sq mi
9	8 21	Over target and South	11 4	−5	11 4	−5	0.15-0 28	88	Yes	Yes	20+ sq mi
10	8 21	Over target and South	11 4	−5	11 4	−5	0 14	130	Yes	Yes	20+ sq mi
11	9 29	ESE side of target and Piute Pass	14 0	−8	14 0	−8	0 10-0 20	60	Yes	Yes	10-20 sq mi
		Average	12 8	−1 0	13 1	−1 6	0.19				

1/ in 1000's of feet

Total Silver Iodide used for seeding 965 grams

Figure 9. Test Case Locations, Bear Creek Basin Seeding Program, Project 21-68-2

TABLE 14 CLOUD AND PRECIPITATION DATA KINGS RIVER AREA SEEDING, PROJECT 21-68-2

Test Case No	Date	Location or Line	Cloud Base Alt 1/	Cloud Base Temp, °C	Seed Alt 1/	Seed Temp	LWC gm/m³	AgI Used gm	Precip	Precip on Ground	Area of Precip
1	6 5	Wishon Tehipite	10 7	−5	10 7	−5	–	85	Yes	Yes	6 sq mi
2	6 5	Cherry Gap-Patterson Mt	7 6	+2	7 6	+2	–	77 5	Yes	Yes	1 sq mi
3	6 6	Courtright Balch	9 6	−0 5	15 3	−10	–	140	Yes	Yes	15 sq mi
4	7 5	Mitchell Pk	16 0	−4 5	16 0	−4	0 10	154	Yes	Yes	6 sq mi
5	7 8	Spanish Mt Kearsarge	12 0	+3	12 0	+3	–	52	Yes	Yes	wide spread
6	7 9	Tehipite Kearsarge	11 7	+2 5	11 7	+2 5	–	239	Yes	Yes	wide spread
7	7 27	So Fork of Kings River-Cedar Grove	13 5	+2	13 5	+2	0 20-0 30	85	Yes	Yes	wide spread
8	7 28	Wishon to 10 mi East	12 5	+6	16 7	−4	0 15	30	Yes	No	1-2 sq mi
9	7 29	Cedar Grove	12 5	+4	12 5	+4	0 15	45	Yes	Yes	40+ sq mi
10	8 13	Tehipite Cedar Grove	10 6	0	11 0	−0 5	0.28	30	Yes	Yes	20 sq mi (crest)
11	8 21	Grant Grove	8 3	+1	8 3	+1	0 12	30	Yes	Yes	20 sq mi
		Average	11 4	+1 0	12 3	−0.8	0 19				

1/ in 1000's of feet

Total Silver Iodide used for seeding 967 5 grams

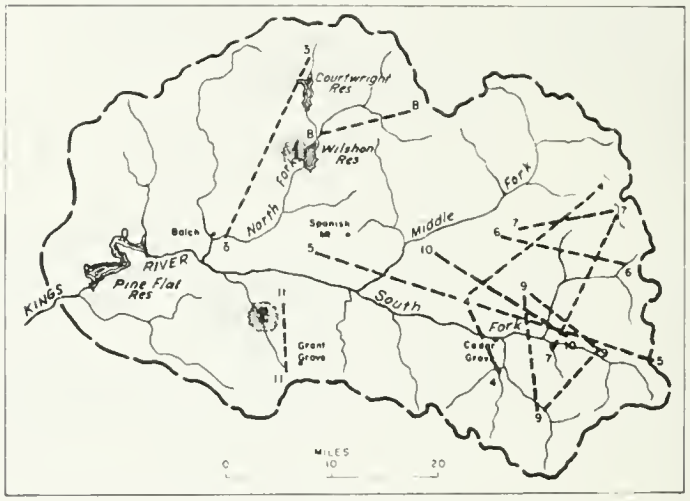


Figure 10. Seeding Tracks, Kings River Area Seeding Program, Project 21-68-2

Southern Sierra Research Program (21-68-3)

Atmospherics Incorporated, under contract to the Naval Weapons Center, China Lake, California, conducted an applied research program using pyrotechnic units disbursed from aircraft. Provisions of the contract included the actual application of pyrotechnic-generated silver iodide, measurements of meteorological parameters, photographic coverage, data collection and reduction, reports, and other such

activities as appeared appropriate to the Naval Weapons Center cloud physics and operational weather modification interest. Specific goals set forth in the contract are to:

1. Provide further information on the effectiveness of more modern pyrotechnic cloud seeding devices.

2. Develop information on seeding effects related to the point of dispersal within the cloud.

3. Attempt to optimize the seeding rates.

4. Provide temperature profiles of the environment surrounding the seeded clouds.

5. Measure the inflow associated with cumulus cells chosen for treatment with pyrotechnics.

6. Provide background measurements of freezing and condensation nuclei near some of the treated clouds.

7. Improve the hardware currently in use for mounting pyrotechnic seeding devices on aircraft.

Twenty seeding flights were made over the Southern Sierra Range in California in the region shown in Figure 11 to document visual effects associated with the application of pyrotechnic-generated silver iodide nuclei. These flights can be placed in two categories:

1. The selection of a pair of similar cumulus turrets and the subsequent random choice of one turret within this pair for treatment.

2. When no pairs of cumulus turrets were available, a single cumulus tower was picked for treatment and physical characteristics documented.

The four flights during the water year 1967-68 were all in category two; single towers were seeded. The 16 flights during June 1967 through September 1967 were summarized in the report on the Sierra Cumulus Project (21-67-2) in DWR Bulletin No. 16-67, "Weather Modification Operations in California," August 1968 (page 20 and Appendix A, page 29).

In addition to the photographic effort associated with several of these seeding

Figure 11. Operational Area, Project 21-68-3

efforts, measurements of condensation and freezing nuclei, as well as temperature profiles, were obtained during a few of the flights. In some cases the inflow at cloud base was measured, with the aircraft used as a sensing platform for vertical air motion. Tables 15, 16, and 17 summarize the pyrotechnic seeding flights accomplished in the Southern Sierra Range of California during the water years 1966-67 and 1967-68. The tables were taken from a report on the Southern Sierra Range Project prepared by Atmospherics Incorporated, Fresno, California.

TABLE 15. CLOUD AND PRECIPITATION DATA CLOUD PAIRS SEEDING, 1966-67

Date (1967)	Flt No	Time Takeoff	Time Land	Flt Time, Hrs	Cloud Base Alt 1/	Cloud Base Temp, °C	Cloud Top Alt 1/	Cloud Top Temp, °C	AgI Used, gm	Precipitation Seeded Cloud	Precipitation Nonseeded Cloud
6/14	1	1529	1835	3.1	8.8	+6	19.0	2/	120	Yes	No
6/17	2	1204	1428	2.4	13.8	-3	20.0	-14.5	120	Yes	No
6/17	3	1500	1630	1.5	12.8	0	21.0	-15.0	120	Yes	No
6/18	4	1242	1617	3.6	14.8	-4.5	30.0	-43.0	120	Yes	No
7/29	5	1038	1454	4.3	12.7	+3.5	26.0	2/	120	Yes	No
7/30	6	1054	1500	4.1	13.2	+2.5	24.0	2	120	Yes	No
Totals				19.0					720		

1 in 1000's of feet

2/ not monitored

TABLE 16 CLOUD AND PRECIPITATION DATA SINGLE CLOUD SEEDING, 1966-67

Date (1967)	Flt. No.	Time Takeoff	Time Land	Flt Time, hrs	Cloud Base Alt 1/	Cloud Base Temp, °C	Seeding Alt 1/	Seeding Temp, °C	AgI Used, gm	Precip Reached Ground
7/12	1	1332	1648	3.3	14.6	-0.5	14.7	-0.5	84	Yes
7/13	2	1316	1632	3.3	12.7	+6.0	13.0	+3.0	56	Yes
8/23	3	1103	1308	2.1	14.0	+1.0	14.0	+0.5	240	Yes
8/24	4	1045	1344	3.0	13.5	+2.0	13.5	+2.0	250	Yes
8/25	5	1115	1310	1.9	12.6	+3.0	12.5	+3.0	480	Yes
8/26	6	1400	1515	1.3	12.9	+2.0	12.9	+2.0	120	Yes
9/3	7	1152	1530	3.6	10.0	+9.0	10.0	+9.0	490	Yes
9/18	8	1551	1719	1.5	11.0	+1.5	11.0	+1.5	240	Yes
9/24	9	1153	1459	3.1	11.7	+0.5	12.0	+0.5	480	Yes
9/25	10	1526	1758	2.5	13.7	-2.0	13.7	-2.0	250	Yes
Totals				25.6					2,690	

1 in 1000's of feet

TABLE 17 CLOUD AND PRECIPITATION DATA SINGLE CLOUD SEEDING, PROJECT 21-68-3

Date Date (1968)	Flt No	Time Takeoff	Time Land	Flt. Time, hrs	Cloud Base Alt 1	Cloud Base Temp, °C	Seeding Alt 1	Seeding Temp, °C	AgI Used, gm	Precip Reached Ground
3/25	11	1443	1732	2.8	5.7	+6.0	5.7	+6.0	210	Yes
4/2	12	1422	1628	2.1	4.0	+4.5	4.0	+4.5	210	Yes
4/12	13	1503	1632	1.5	11.7	-5.0	11.7	-5.0	70	Yes
5/10	14	1415	1617	2.0	13.4	-6.0	13.4	-6.0	210	Yes
Totals				6.4					700	

1 in 1000's of feet

Upper Santa Ana River Watershed Weather Modification Project (22-68-1)

Between approximately October 1, 1967 and April 1, 1968, San Bernardino Valley Municipal Water District conducted a weather modification project to increase precipitation in the Santa Ana River Watershed lying east of Lytle Creek and north of the San Bernardino County line.

Seventeen ground-based generators, as listed in Table 18, were operated in and adjacent to the target area shown in Figure 12. The generators disbursed a two-percent solution of silver iodide dissolved in a solution of sodium iodide and acetone at a rate of 15 grams silver iodide per burner per hour.

No pyrotechnic devices were used during the 1967-68 season.

The seeding record for 1967-68 is missing.

TABLE 18. GENERATOR LIST, PROJECT 22-68-1

Generator No.	Generator Location
1	Running Springs
2	Big Bear Dam
3	Big Bear Lake
4	Seven Oaks
5	Camp Angelus
6	Forest Home
7	Mill Creek
8	San Bernardino
9	Rialto
10	Fontana
11	Pedley
12	Corona
13	Chino
14	Upland
15	Twin Peaks
16	Rim Forest
17	Box Spring Mountain

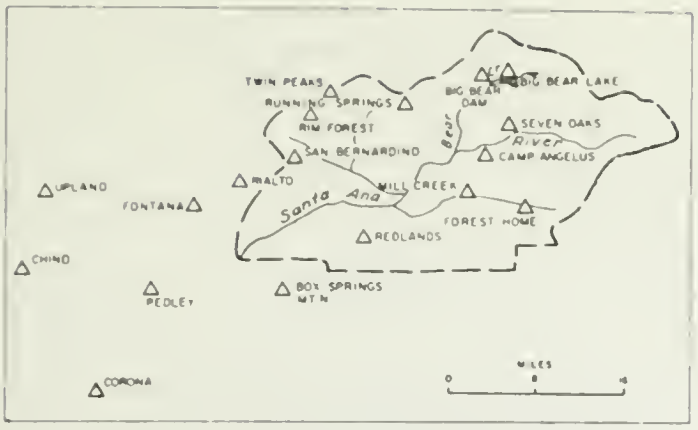


Figure 12. Target Area and Generator Locations. Project 22-68-1

Lake Almanor Cloud Seeding Project (23-68-1)

Between December 2, 1967 and May 13, 1968, Pacific Gas and Electric Company (License No. 23) conducted weather modification project operations on its own behalf. This project was conducted to increase the snowpack and was operated on a random basis in order to better evaluate the effect of seeding. Equipment was operated in Plumas, Lassen, Tehama and Shasta Counties. The target area, Figure 13, was the drainage basin of Lake Almanor and Mountain Meadows Reservoir in the Northern Sierra. Silver iodide crystals were dispursed at a rate of 25.4 grams per burner per hour. Monthly totals of generator-hours for each generator are presented in Table 19. Distribution of generator-hours by day is given in Table 20.

TABLE 19 GENERATOR HOURS OF OPERATION BY MONTH, PROJECT 23-68-1

Gen No	Location	Dec	Jan	Feb	Mar	Apr	May	Total
1	Christie Hill	0	22.0	0	132.8	37.6	0	192.4
2	Butt Mountain	80.8	152.0	54.7	143.7	37.6	11.0	479.8
3	Stover Mountain	126.2	152.0	54.7	19.2	37.6	11.0	400.7
4	Ohio Ridge	38.5	119.0	54.7	8.2	9.5	11.0	240.9
5	Keefer Ridge	0	99.0	54.7	113.8	29.2	11.0	307.7
6	Dyer Mountain	119.2	119.0	32.7	0	9.5	11.0	291.4
7	Feather River Meadows	0	0	0	142.8	37.6	11.0	191.4
	Totals	364.7	663.0	251.5	560.5	198.6	66.0	2,104.3

TABLE 20 SUMMARY OF OPERATIONS PROJECT [illegible]

Month	No. of Storms	Days of Seeding	Ag. [illegible]
December	15	9	[illegible]
January	14	9	[illegible]
February	5	5	[illegible]
March	16	1	14,367
Apr	4	4	5,046
May	1	1	676.4
Totals	55	39	53,439.5

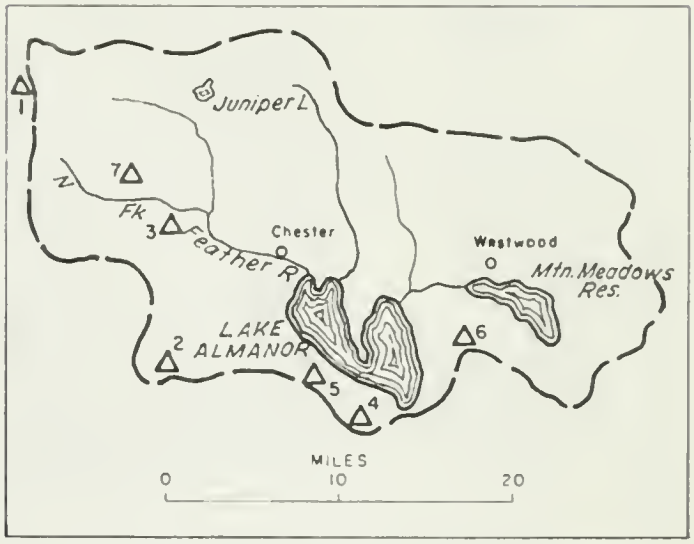


Figure 13. Target Area and Generator Locations, Project 23-68-1

Santa Clara County Weather Modification Project (26-68-1)

Santa Clara County Flood Control and Water District conducted weather modification operations on its own behalf between November 29, 1967 and March 17, 1968. This project was conducted to increase precipitation and consequently, water supply. The target area was the area within Santa Clara County.

Modified starfire ground generators emitting silver iodide at a rate of 25 grams per hour per generator were used.

Monthly totals for generator-hours for each generator are presented in Table 21. A summary of project operations are summarized in Table 22. Figure 14 is a map of the project area and generator locations.

TABLE 21 GENERATOR HOURS OF OPERATION BY MONTH, PROJECT 26-68-1

Gen No	Location	Nov	Dec	Jan	Feb	Mar	Total
1	Skyline Blvd Los Gatos	2 1	6 3	36 2	16 3	5 4	66 3
2	Skyline Blvd , Los Gatos	3 1	29 5	37 5	26 4	16 3	112 8
3	Skyline Blvd , Los Gatos	2 0	30 1	39 7	3 7	15 8	91 3
4	Almaden Air Force Base	2 5	18 4	21 3	16 0	11 2	69 4
5	Highland Way, Los Gatos	0 0	9 4	35 2	22 6	14 8	82 0
6	Riverside Road, Watsonville	0 0	6 3	10 1	9 2	11 8	37 4
7	Bella Vista Lane, Watsonville	1 7	13.3	37 6	25 4	20 3	98 3
8	Morten Ave Santa Cruz	0 0	23 8	35 3	3 3	7 1	69 5
9	Old Soquel Road, Santa Cruz	0 0	0 0	34 4	0 0	8 2	42 6
10	Corralitos Road, Corralitos	0 0	7 3	28 9	0.0	7 7	43 9
11	San Juan Bautista	0 0	6 4	1 1	20 7	16 3	44 5
12	Salinas	0 0	2 2	0 0	0 0	4 7	6 9
13	Salinas	0 0	0 0	0 0	0 0	4 8	4 8
14	Salinas	0 0	2 3	0 0	0 0	4 9	7 2
15	Peckham Road, Watsonville	0 0	6 0	7 1	7 4	10 3	30 8
16	Hollister	0 0	2 0	0 0	3 7	2 2	7 9
17	Gilroy	0 0	3 1	18 6	5 6	13 0	40 3
18	Morgan Hill	0 0	6 4	14 8	7 4	12 9	41 5
19	San Juan Bautista	0 0	2 9	0 0	9 8	19 6	32 3
20	Hollister	0 0	2 9	3 7	6 6	9 2	22 4
21	Eureka Canyon Road, Watsonville	1 2	20 1	32 7	12 5	12 5	79 0
22	Radar Trailer County Communications	0 0	6 0	0 0	0 0	0 0	6 0
	Totals	12 6	204 7	394 2	196 6	229 0	1037 1

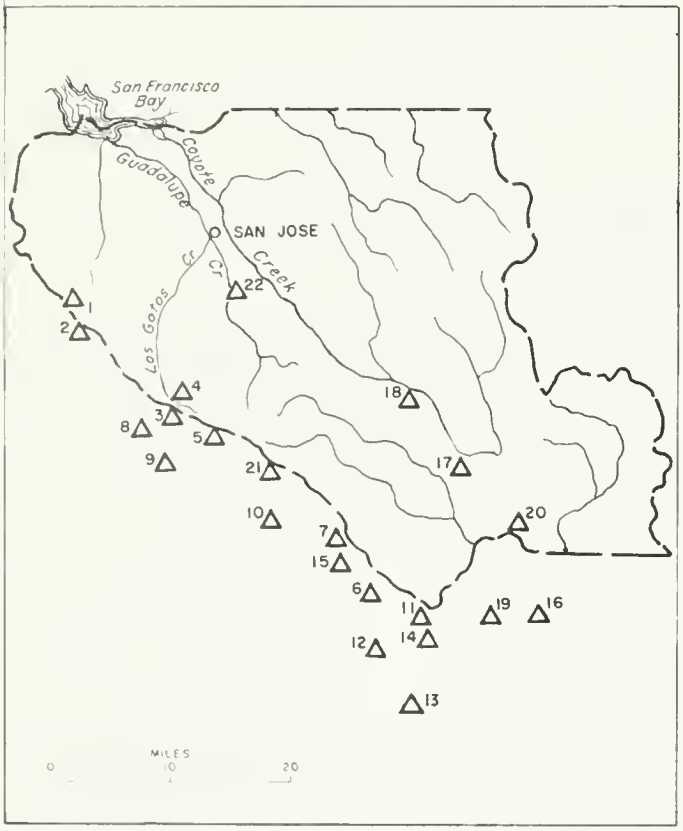


Figure 14. Target Area and Generator Locations, Project 26-68-1

TABLE 22 SUMMARY OF OPERATIONS, PROJECT 26-68-1

Month	No of Storms	Days of Seeding	AgI Used, gm
November	1	1	315
December	4	6	5,117
January	4	4	9,854
February	4	5	4,917
March	4	4	5,725
Totals	17	20	25,928

Fog Dispersal Program (29-68-1)

From mid-November 1967 through February 1968, World Weather Incorporated conducted fog-dispersal operations for the Air Transport Association of America at three airports in and around Sacramento. Twenty-six operations on 25 days were conducted at the Sacramento Metropolitan Airport, seven at the Sacramento Municipal Airport, and one at the Stockton Municipal Airport.

The operations report presented by the licensee is provided in Table 23.

EXPLANATION OF SYMBOLS AND ABBREVIATIONS IN TABLE 23

Airport:
SMF = Sacramento Metropolitan
SAC = Sacramento Municipal
SCK = Stockton Municipal

Group Designation assigned by licensee

Sky and Ceiling Sky cover symbols are presented in ascending order Figures preceding the symbols are cloud heights in hundreds of feet

Sky cover symbols

○ Clear less than 0 1 sky cover

◐ Scattered 0 1 to less than 0 6 sky cover

◑ Broken 0 6 to 0 9 sky cover

⊕ Overcast more than 0 9 sky cover

– Thin (when prefixed to above symbols)

–X Partial obscuration 0 1 to less than 1 0 of the sky hidden by precipitation or obstruction to vision, e g , fog

X Obscuration sky completely hidden by precipitation or other obscuration

The letter preceding height of the cloud layer identifies the ceiling layer and indicates how the ceiling height was obtained

E indicates that heights of noncirriform clouds were estimated.

M indicates that cloud heights were measured

U indicates that the height of cirriform ceiling layer was unknown.

/ indicates that height of cirriform nonceiling layer was unknown.

W indicates that the height of the ceiling layer was indefinite

RVR Runway visual range, i.e , the extreme low value of the range of vision along the runway for ten minutes prior to observation A + sign following the number indicates values greater than the number. A – sign indicates values smaller than the number.

Materials Active agents were classified by the licensee as follows

A, C, H, indicates active polyelectric agents

B, D, E, F, G, indicates active agents that were liquid or solid surfactants

N A Data not available

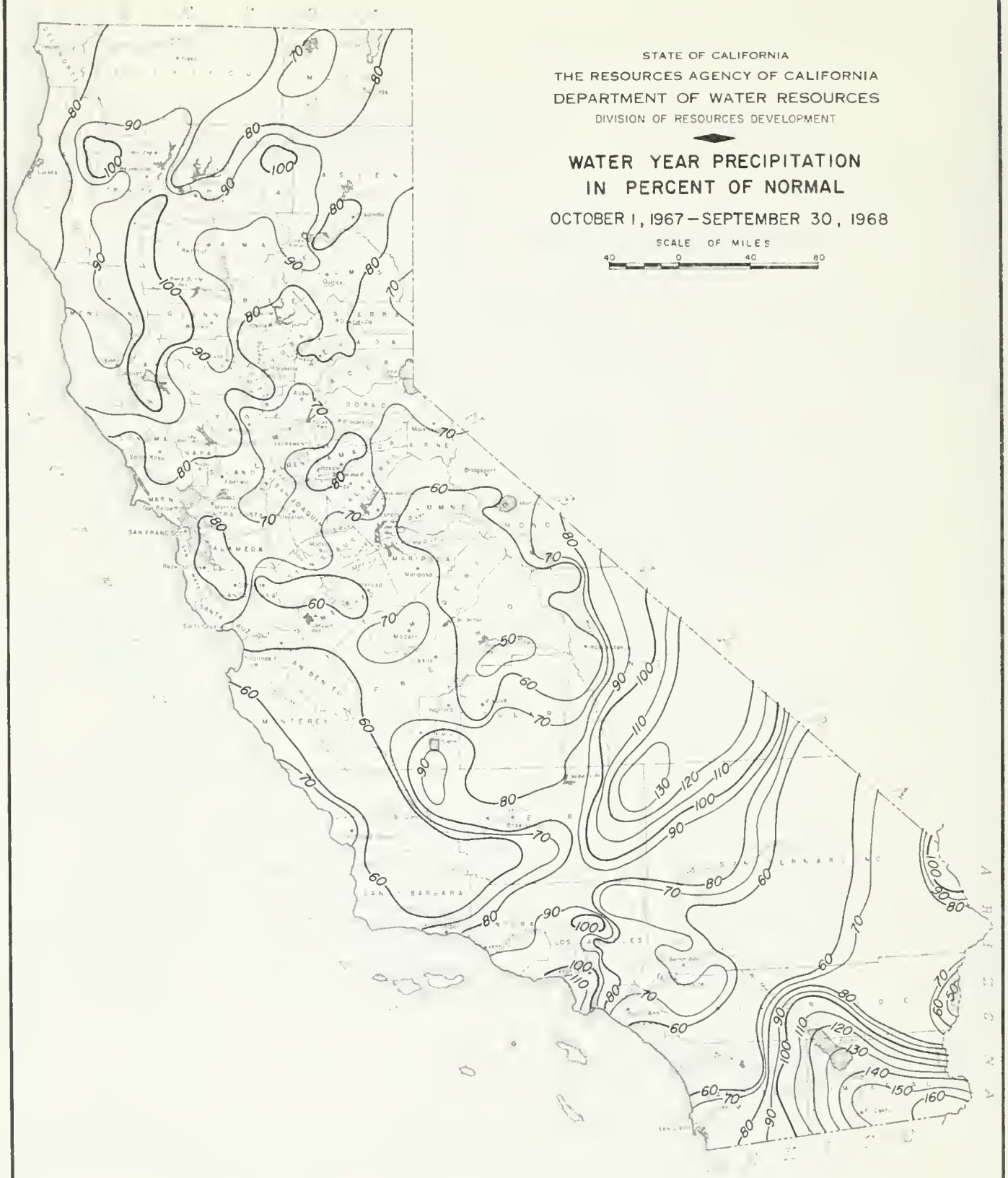
TABLE 23. OPERATIONS REPORT, PROJECT 29-68-1

Date	Airport	Group	Weather Before Seeding Operations: Sky and Ceiling	Visibility and Obstruction to Visibility	Temperature, °F: Air	Dewpoint	RVR	Weather After Seeding Operations: Sky and Ceiling	Visibility and Obstruction to Visibility	Temperature, °F: Air	Dewpoint	RVR	Total Seeding Time: Hr	Min	Material and Amount Used in Pints or Pounds
11-20-67	SMF	A	*0X	1/8 mi. fog	53	53	N A	-X	3 mi fog	56	N A	N A	0	45	A-32 B-3
11-22-67	SMF	A	W1X	1/16 mi fog	47	47	N A	-X	3/4 mi fog	48	48	N A	1	17	A-24 B-2 E-8
12-10-67	SMF	A	-X	1/4 mi fog	32	31	N A	-X	1 mi. fog	32	31	N A	1	00	B-50, E-30
12-10-67	SAC	A	*1X	1 mi fog	32	31	1300 ft.	-X	1 mi. fog	33	32	6000+ ft	0	30	A-25, B-10, E-5
12-19-67	SAC	A	*1X	1/8 mi. fog	32	21	3/8 mi	5⊕	3 mi fog	37	33	1½+ mi	3	22	A-160, B-25, D-20 E-12
12-21-67	SMF	A	-X	1/4 mi fog	31	31	N A	150⊕	3 mi. fog	32	31	N A	0	31	A-80, B-7, D-24 E-15
12-21-67	SAC	A	-X	1 mi. fog	28	28	1/4 mi.	150⊕	3 mi fog	29	29	1¼+ mi.	0	24	A-5, B-20, E-50
12-25-67	SMF	A	○	3 mi fog	33	30	600 ft	-X	3 mi fog	44	38	6000+ ft	3	00	B-10, D-25, E-45, G-13
12-26-67	SMF	A	-X	3 mi. fog	33	29	800 ft.	-X	1½ mi. fog	38	35	6000+ ft	3	52	B-25, D-30, E-60, G-5
12-31-67	SMF	A	W1X	1/8 mi. fog	39	36	1400 ft	W2X	3/4 mi. fog	40	36	5000 ft	0	56	B-70, C-50, D-350, E-180
1-2-68	SAC	A	-X	3/8 mi. fog	30	30	3/16 mi.	W2X	1½ mi fog	29	28	1½+ mi.	0	07	A-5, B-20, D-50
1-3-68	SMF	A	*1X	5/8 mi. fog	31	28	600 ft	W2X	5/8 mi. fog	33	30	2600+ ft.	2	38	A-70, B-50, C-25, D-150, E-40
1-4-68	SMF	A	-X	1/8 mi. fog	27	22	600 ft	-X	½ mi. fog	29	23	6000+ ft	2	23	B-50, C-25, D-150, E-50
2-3-68	SMF	A	W0X	1/8 mi. fog	48	45	1400 ft	W2X	5/16 mi. fog	49	46	3500 ft	1	02	B-50, E-35, F-20
2-4-68	SMF	A	W0X	1/4 mi. fog	42	40	2400 ft.	W2X	3/8 mi. fog	43	40	6000+ ft	1	07	A-65, B-50, E-35, F-20
2-7-68	SAC	A	-X90⦶	1/8 mi. fog	44	44	1/8 mi.	90⦶	2 mi fog	48	48	1½+ mi	0	45	B-50, E-30, F-50
2-8-68	SMF	A	W1X	1/8 mi. fog	45	43	1/8 mi.	W2X	3/16 mi. fog	45	41	½ mi.	0	55	A-45, B-75, C-50, E-100
2-12-68	SMF	A	-XU⊕	1 mi. fog	41	37	1000 ft	-X1⦶	1 mi. fog	46	41	6000+ ft	0	57	B-105, E-35, H-280
2-25-68	SMF	A	-X	1/8 mi. fog	50	45	1400 ft	○	15 mi. fog	51	47	6000+ ft	0	28	B-50, F-120, H-210
12-19-67	SMF	B	W2X	½ mi fog	32	31	N A	○	5 mi	36	33	N A	0	50	B-12, E-75, G-120
12-27-67	SMF	B	-X	3 mi fog	40	36	N A	-X	3/4 mi. fog	39	34	4000 ft	2	37	B-15, C-12, D-15, E-35, G-10
11-19-67	SMF	C	20⊕	10 mi.	57	52	N A	40⦶	10 mi.	59	54	N A	1	15	A-80, E-12
11-21-67	SMF	C	-X	5 mi	46	45	N A	○	10 mi	47	45	N A	0	30	A-56, B-7, D-24, E-15
12-15-67	SMF	C	-X	5 mi	50	24	N A	-X	6 mi.	46	26	N A	0	27	A-4, D-10, E-5
12-24-67	SMF	C	○	4 mi.	31	27	6000 ft.	1-⦶	4 mi.	37	32	6000 ft	1	18	B-5, D-18 E-22 G-10
12-31-67	SAC	C	W3X	3/4 mi. fog	39	38	1½ mi.	W4X	1½ mi. fog	40	39	1½+ mi.	0	11	B-50, C-50, D-350, E-130
2-2-68	SMF	C	M5⊕	2 mi. fog	49	45	6000 ft	E45⊕	1½ mi. fog	52	46	6000 ft.	0	22	E-30, F-50
2-18-68	SMF	C	-XE22⊕	2 mi. fog	55	50	4000 ft.	-XE22⊕	2 mi. fog	55	50	6000 ft.	0	03	H-8
2-19-68	SMF	C	W15X	1¼ mi. fog	56	52	4500 ft.	-XE10⊕	1½ mi. fog	56	52	6000 ft.+	0	55	B-12, F-75, H-120
2-25-68	SAC	C	M4⦶	1 mi. fog	52	52	1½ mi.	4⦶/-⦶	6 mi. fog	52	52	0	0	08	B-50, F-120, H-210
11-23-67	SMF	D	W1X	1/4 mi. fog	47	46	N.A.	W2X	3/8 mi. fog	45	44	N.A	1	40	A-100, B-10, D-10, E-100
12-31-67	SMF	D	W0X	1/16 mi. fog	38	35	800 ft.	W0X	1/16 mi. fog	38	34	600 ft.	0	52	B-40, C-10, D-5, E-50
1-2-68	SMF	D	-X	1 mi. fog	28	24	800 ft.	-X	1/4 mi. fog	28	24	1000 ft.	0	22	A-5, B-20, C-10, D-50
1-20-68	SCK	D	W0X	0 mi. fog	34	31	1/8 mi.	W0X	0 mi. fog	35	33	1/8 mi.	1	13	A-40, C-50, E-35, H-50

Remarks by Contractor (Group D)

11-23-67	Seeding pumps burned out. Repairs could not be made while airborne
12-31-67	Air traffic control problems prohibited sufficient runs.
1-2-68	Chemicals were exhausted and were unable to return for more.
1-20-68	Navigation aids went out of commission.

Figure 15


STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES DEVELOPMENT
WATER YEAR PRECIPITATION
IN PERCENT OF NORMAL
OCTOBER 1, 1967 – SEPTEMBER 30, 1968
SCALE OF MILES
40 0 40 80

APPENDIX A
SEASONAL PRECIPITATION SUMMARY

The following summary of statewide precipitation during the 1967-68 water year is provided as background for reviewing weather modification operations. The water-year and monthly precipitation normals were based on the 35-year period 1931-65.

Statewide precipitation during the 1967-68 water year was about 75 percent of normal.

The Colorado Desert area was the only major hydrographic area with near normal precipitation for the 12-month period. The Lahontan Area, located north of the Colorado Desert and east of the Sierra Nevada Mountains, averaged somewhere near 90 percent of normal with heaviest amounts in the southern portion.

Approximately 80 percent of normal precipitation fell in the South Coastal area, decreasing to 60 percent in the Central Coastal area and increasing to 85 percent in the North Coastal area.

Precipitation in the Sacramento Valley Hydrographic area, similar to the North Coast, was about 85 percent of normal, while the San Joaquin Valley was drier with 65 percent.

In the North Coastal and Sacramento Valley areas, above normal precipitation fell during only two months -- January and August -- of the 12-month period, with about 150 percent of normal and greater than 1,000 percent, respectively. The very high percentage value in August was the result of an exceptional three-day storm occurring in a usually very dry month.

There were four months of above normal precipitation in the South Coastal area -- November, March, July, and August. The November precipitation in Southern California resulted from a wave formation on an otherwise unpretentious front. This wave moved through Southern California, producing about eight inches of precipitation in lowland areas and up to about fourteen inches in the mountains. Downtown Los Angeles had the heaviest three-day rain (7.96 inches) since the New Year's Day Flood of 1934.

Thus, both feast and famine occurred during the water year 1967-68, with famine predominating.

Seasonal precipitation in percent of normal is shown in Figure 15.

More detailed information on both precipitation and general water conditions in California during the 1967-68 water year may be found in Department of Water Resources Bulletin No. 120-68, "Water Conditions in California: Fall Report", October 1968.

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